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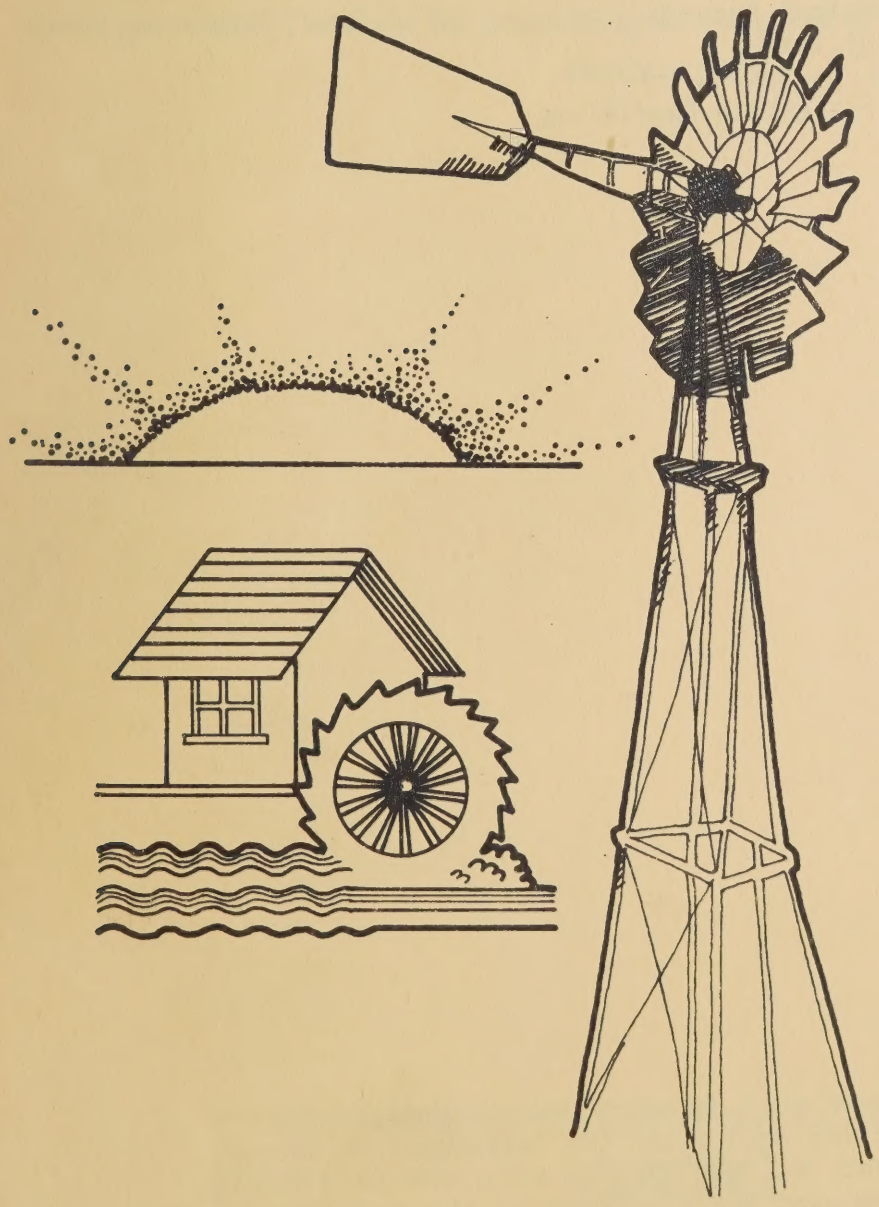
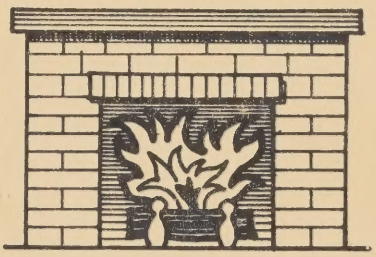
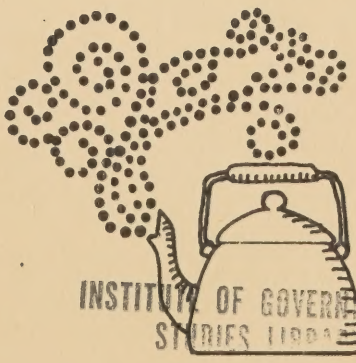
RENEWABLE ENERGY
For the Future

Local government options for promoting development of renewable energy resources

October 1981







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Association of Bay Area Governments

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Table of Contents

PAGE

I INTRODUCTION - WHY RENEWABLE ENERGY? 1

ENERGY SUPPLY 2
ENERGY DEMAND 2
RENEWABLE ENERGY RESOURCES 3

II RENEWABLE ENERGY RESOURCES: WHAT ARE THEY? 5

SOLAR ENERGY. 7
WIND ENERGY 10
ENERGY FROM BIOMASS 12
HYDROELECTRIC ENERGY. 15
GEOTHERMAL ENERGY 17

III OPTIONS FOR LOCAL GOVERNMENTS: HOW DO YOU DEVELOP RENEWABLE ENERGY RESOURCES? 19

RENEWABLE RESOURCE DEVELOPMENT OPTIONS. 19
INSTITUTIONAL FRAMEWORK 21
FINANCING 22

APPENDIX A - Public Utility Regulatory Policies Act of 1978 (PURPA) and California's Response 27

APPENDIX B - Who To Contact About Renewable Energy?. 29

GLOSSARY 30

BIBLIOGRAPHY 32

Tables and Figures

Table 1 - Summary of Renewable Energy Resource Characteristics 6

Table 2 - Procedure for Evaluating Local Renewable Resources 20

Figure 1 - Conversion of Renewable Resources to Energy 4

Figure 2 - Responsibility of Public Agency and Private Individual or Firm in Renewable Development 22

I. Introduction — why renewable energy?

The energy supply system in this country has recently shown signs of moving toward decentralization--to smaller-scale facilities and localized control. As it does, local officials are faced with decisions on the extent to which they should become involved in energy development.

Installing a cogeneration plant or leasing residential solar water heaters may not be desirable or feasible for every city or county. But there are many opportunities open to local governments wishing to develop energy resources, particularly those that are renewable and available locally. This booklet is intended to help local officials in making those choices about their energy future.

Basically, local governments can:

- become power producers,
- promote development of locally-available renewable energy supplies, or
- help private individuals and firms use renewable energy.

Such local initiative in renewable energy resources can result in:

- increased self-reliance by the community, with decreased dependence on a centralized power supply, and reduced vulnerability to disruptions of "outside" energy supplies;
- production of revenue that may return to the local agency; and
- benefits to the local economy through (1) jobs associated with

development of renewable resources, (2) community retention of money spent on energy, and (3) increased attractiveness of the locale to industry.

The California Energy Commission's 1981 Biennial Report, Energy Tomorrow: Challenges and Opportunities for California, anticipates the growing importance of renewable energy in our future supply picture.

> "Even under current trends, California's energy future will be more diversified than the energy system of today. Solar thermal applications such as solar water heating, pure alcohol fuels, and biomass are projected to be making measurable contributions to the California total energy system of the year 2000. Geothermal, cogeneration, and wind energy power plants may be generating twice as much electricity in the year 2000 under current trends than all of California's nuclear and coal plants generated in 1979. With this diversification, California's energy future would not be tied to the successes of any single energy resource. Similarly, California's energy system is likely to be more resilient in its response to oil supply and other fuel supply disruptions."

Cities and counties can sit by and watch as our future energy system emerges. Or they can actively participate in its evolution and help to ensure that their own residents and businesses benefit. Development of renewable energy resources is an important opportunity for local governments to help shape California's energy future.

Energy supply

The energy supply system in California and the Bay Area is made up of a centralized generation and distribution system. Electric power generation is done by large investor-owned utilities, along with a small number of municipally-owned utilities. The supply system can be characterized by:

- centralized institutional structures for fuel exploration, development, power generation and distribution;
- major capital investment for the required infrastructure;
- dependence on fossil-fuel, non-renewable sources of energy; and
- equipment and facilities that are sophisticated and technically complex.

By nature of the system, cities and counties currently play an insignificant role in influencing energy supply. Planning and regulation happen in state and federal agencies; national and international circumstances affect quantity and prices of fuels.

Energy Demand

Total energy demand or consumption is the aggregate of every individual decision or choice to use energy. Energy demand, then, is very

individual, localized, and decentralized. Public regulation of demand usually occurs at the state and, occasionally, the local levels.

However, local governments are in an excellent position to influence how we use energy. Energy conservation is an obvious and practical first line of action for reducing energy waste and softening the impact of rising energy prices. Most local governments have taken steps in their own buildings and facilities. Many are exploring and implementing ways to encourage or require their residents and businesses to conserve energy. For example, Pacifica, Pleasant Hill, and Sunnyvale have all held energy fairs to educate residents. Santa Clara County, Livermore, and Berkeley have local ordinances that require energy efficient measures or solar energy applications.

Renewable energy resources

Renewable energy resources offer an alternative to the conventional energy supplies. They may be defined as:

> Energy resources that are sustainable over time, such as solar, wind, biomass, geothermal, and hydropower.

Their development and use is generally characterized by:

- decentralized facilities producing small amounts of power;
- less complex technologies (often known for centuries but recently enhanced by advances in materials and efficiency);
- daily, seasonal and annual variations in full availability of the resource; and
- locally available resources that cannot in some cases be transported readily.

Renewable energy resources may be used for producing electricity or for directly doing work. For example, geothermal steam may drive turbines or may be used for space heating. Solar energy may heat water or in the future produce electricity in the home.

Use of renewable energy to heat water in one home or to generate a few megawatts of electricity may not seem like a significant contribution to our total energy needs. But cumulatively the effect could be very important.

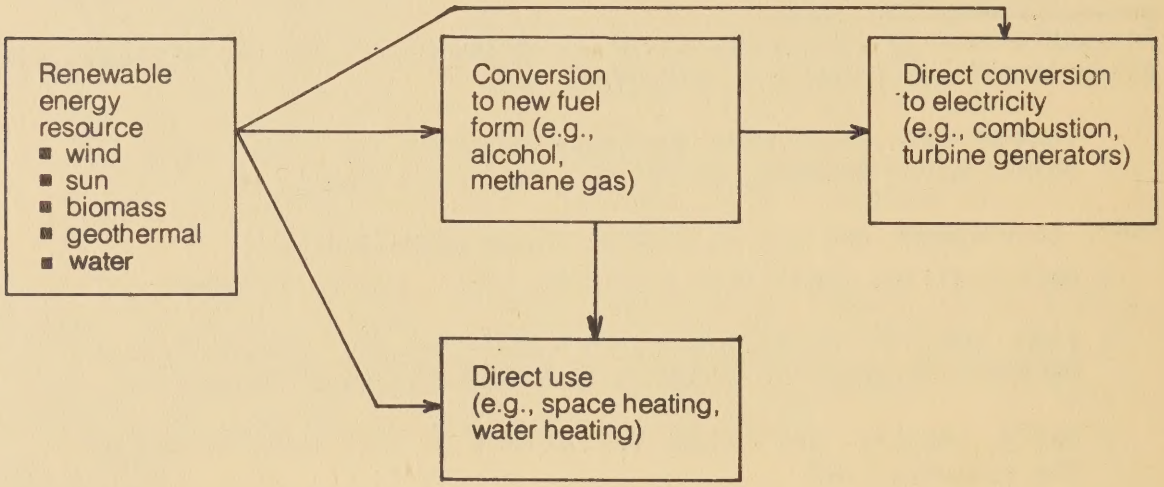
Characteristics of renewable energy resources
• Non-fossil fuel
• Sustainable over time
• Decentralized generation and distribution system
• Locally available supplies

Characteristics of non-renewable energy resources
• Fossil fuels
• Not sustainable over time
• Centralized generation and distribution system
• High technology
• "Imported" supplies

Development of renewable energy is already being done by private industry, public utilities, and local governments. A body of experience on technologies, institutional structure, and financing is growing that smooths the way for future efforts. At the very least local governments need to be attuned to renewable energy efforts in their own communities. Beyond this there are actions that a local government may take to promote renewable energy development.

Figure 1.

Conversion of renewable resources to energy



Other sources of information

This guidebook is only a starting point for those considering renewable energy development. The references in the text, the bibliography, and the list of contacts are intended to guide the reader to other, more detailed, sources of information. In particular, see:

- Energy information phone numbers in Appendix B
- Descriptions of other cities and counties planning and implementing projects in Chapter II
- Bibliography

II. Renewable energy resources: what are they?

Renewable energy resources offer an alternative to the conventional energy supply system. In general, renewable energy is characterized by:

- fuel supplies that are sustainable over time;
- localized development and use of the energy resource;
- decentralized, small scale power facilities; and
- small to moderate capital investments in equipment and facilities and relatively short lead times for full operation to occur.

Individual renewables resources may have perceived difficulties as well. For example, intermittent availability of the resource may decrease capability to produce dependable electricity. Certain resources carry their own set of environmental impacts. Yet, an energy system that includes a mix of renewable and non-renewable energy supplies and of centralized and smaller-scale decentralized facilities will be less vulnerable to major disruptions.

An energy resource must be collected, converted to usable power, and distributed. Each renewable resource has special qualities of availability, amount, and geographic distribution. The following descriptions summarize each resource's key characteristics and the issues important for local government development. (See Table 1 for a summary.) Examples of local success stories are also included.

It should be noted that the five resources included here are generally accepted as "renewable." Cogeneration is sometimes included under this category. It has been omitted here, because it is in fact a technology and not a resource. For example, cogeneration may be used with renewable energy, such as wood waste, or non-renewable energy supplies, such as natural gas. The California Energy Commission publication, Cogeneration: Energy for the Eighties and Beyond, gives a good summary.

TABLE 1: Summary of Renewable Energy Resource Characteristics

	Fluctuates with time	Development or access constraints	Transport-ability	Direct use	Production of electricity and technology	Environmental impact issues	Major regulatory issues
WIND	daily & seasonally	May be altered by upwind structures	No	Yes, pumping water	Yes, wind turbine generators	Aesthetic, safety, noise	Wind access
SOLAR	daily & seasonally	May be blocked by structures or vegetation	No	Yes, Water heating, space heating & cooling	Yes, but not yet wide spread. Photovoltaics and solar power towers.	Aesthetic	Assurance of solar access
HYDRO-ELECTRIC	Seasonally & annually	Water rights agreements	No	Limited	Yes, turbine generators	On undeveloped streams and rivers, impacts on fish and wildlife.	Water rights
BIOMASS	Some types fluctuate seasonally. Others are constant.	Collection and transportation costs	Yes	Limited	Yes, direct combustion and cogeneration	Air quality impacts; conflict with objectives for waste reduction and reuse.	Air quality regulations
GEOTHERMAL	No	Costs of exploration and development	Limited distances only	Yes, space heating & cooling; industrial and agricultural processing	Yes, steam-driven turbine generators	Air quality, water quality, land use conflicts in rural areas.	Mineral rights

Solar energy

Characteristics

The sun's rays are the "fuel" supply for solar energy. The resource, of course, varies daily and seasonally, presenting special problems in using the energy. Its availability is directly affected by obstructions that block the sun.

Solar energy must be "collected" and converted to a usable form; this process normally requires large areas of collection surface. The solar energy is then either transferred to another medium, such as water, or turned into electricity. Solar energy has three major applications: 1) decentralized space and water heating (including pool heating); 2) decentralized electrical power generation through the use of photovoltaics; and 3) centralized power towers for electricity generation. Solar systems for space and water heating are available now; as yet, solar applications for the production of electricity are only in the demonstration stage and the cost is too high for widespread application. The focus of this section will be on the first use of solar energy, decentralized space and water heating, since these are the most likely solar applications for local government use and promotion. Passive solar systems generally refer to direct use of building structures to collect, store, and distribute the sun's energy. Active solar systems involve mechanical means to carry out these functions (see SUNRAE's publication done for California Energy Commission called Sun-Start, A California Guide to Passive Solar Design).

Resource Assessment

The sun's intensity and availability over time are the key factors for its use as an energy resource. Cloud cover, time of year, and latitude all affect the solar potential. Most of the San Francisco Bay Area is fortunate to have a considerable number of sunny days and high potential for use of solar energy. In order to match solar energy to an application, such as water heating or space conditioning, an assessment of the energy requirements is needed. The degree-day heating statistics are needed to determine this requirement. A degree-day accrues for every degree the average outside temperature is below 65° F for a 24-hour period. Insolation values, or the amount of solar energy received on a flat surface, are also necessary.

Implementation

Solar energy for space and water heating operate with dispersed collection systems at the point of consumption. Local implementation of solar energy requires assuring access to the sun, and promoting individual decisions to install the solar equipment.

Solar Access -- For solar energy to be effective the solar collectors must be free from shading by neighboring trees or buildings. The angle of the sun at different times of the year can affect what areas receive solar energy year-round. A local solar access ordinance is one way to assure that individuals have a right to sunlight. Other options are

solar easements or covenants and restrictions. New development can be designed and sited to allow maximum access to the sun in structures for active or passive systems. (American Planning Association's Protecting Solar Access for Residential Development: A Guidebook for Planning Officials and CEC's Solar Access: A Local Responsibility are good introductions to solar access).

Installation Of Solar Equipment -- Because active and passive solar systems are incorporated into individual homes and businesses, implementation of solar energy requires many discrete decisions and actions. The task of local governments, then, is to encourage, promote or even require the design of structures or the installation of equipment. Possible methods include: the education of people as to the uses and benefits of solar; incentives to encourage installation and use; and local ordinances to mandate its use whenever possible and to protect solar access for individual homes. The cost-effectiveness of individual solar systems will play an important role in persuading individual action to install solar equipment. A local government embarking on a solar program needs to be informed about system cost effectiveness, tax credits, and loan and rebate programs. (Capturing the Sun's Energy - Opportunities for Local Governments by Western SUN presents public policy options for local decision-makers, including various solar ordinances.)

Local success story – solar

Palo Alto, California

The City of Palo Alto (population 55,400) is using a somewhat different approach to developing renewable energy resources. Palo Alto has initiated a municipal solar utility (MSU) which works towards installing active solar hot water heaters on individual homes.

Palo Alto already owns and operates electric, gas, water, sewer, and refuse utilities; the solar utility is being operated as a separate revenue generator for the city. Its MSU is part of the California Solar Utility Development Authority (CSUDA), a joint powers agency made up of Palo Alto and five other California cities, with the purpose of furthering implementation of MSUs. Palo Alto's MSU was started with a short term loan out of the city's system improvement account in late 1980 with assistance from the CEC. In the future the city hopes to issue a bond to provide additional funds for loans; repayment of the loans would be used to retire the bond.

Unlike other forms of direct local government renewable development, Palo Alto's aim is to encourage individual resident and business action, namely to use solar power for heating hot water and for space heating. Their solar program is then designed to further this form of power production and use. Palo Alto's program consists of three phases:

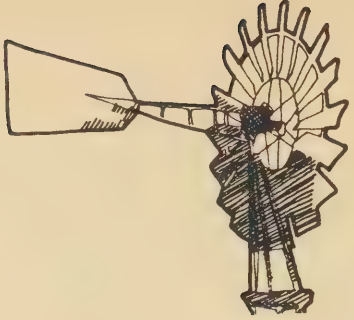
1) Information and consumer assurance efforts - to provide citizens with the best information possible on solar systems.

2) Financing - the MSU will finance up to 100% of an installed solar space heating system, domestic hot water or swimming pool heating system by issuing low interest (8%) loans to both single- and multi-family homes.

3) Incentives and ordinances - electric bill discounts are provided for offsets for running pumps that are used in a solar system. The MSU is working toward providing solar access protection and revising zoning and building codes that inhibit the use of solar systems.

Since its inception, the local response to the MSU has been excellent, with five applications per week being received from homeowners. It has provided a low cost outgrowth of an existing conservation program in the city. While Palo Alto as a municipal utility may have some advantages other communities do not have, any community can establish a municipal solar utility.

CONTACT: Rick McClure, Solar Coordinator, (415) 329-2417.



Wind energy

Characteristics

The wind's energy is transferred into work through the force it applies to the sails of a boat or the blades of a windmill. It fluctuates with time of day and season of the year. As a resource it is also affected by downwind landforms and structures. It is not a resource that can be transported elsewhere, but must be used or converted to another form at the site where it is found.

Wind may be harnessed for direct use, such as pumping water, or for conversion to electricity. Electricity is produced by the wind's kinetic energy driving a rotor which, in turn, drives an electrical generator. The rotor is usually two or three blades mounted on a tower. For large scale power development, several wind machines are grouped together to create a wind farm. Wind turbine generators are now being produced in the 25 kilowatt (KW) to 4 megawatt (MW) range. The California Energy Commission believes that the economics of wind energy are very favorable. As wind machines become mass produced, their cost will drop, making the production of electricity even more competitive with fossil fuels. In their publication Wind Energy - Investing in Our Energy Future, the CEC points out wind energy is only cost-effective in areas with strong and persistent winds. Large wind machines clustered together in wind farms will obtain the maximum return on investment and therefore the lowest cost.

Resource Assessment

To successfully assess wind energy, the site-specific wind resources must be determined, using anemometers to measure wind speed. A minimum annual average wind speed of 10 to 12 miles per hour is needed, and 13 to 14 miles per hour is necessary to have an excellent site. In the San Francisco Bay Area, the Altamont Pass and Carquinez Hills (in Alameda and Solano Counties, respectively) may have locations with average winds in excess of 20 miles per hour. (See CEC report, Wind Energy Assessment of California.)

Implementation

The environmental impacts of wind energy are not significant but may include interference with TV or microwave signals, the visual impact of wind towers and transmission lines, and the potential noise effects. Proper land use policies can minimize these impacts to a large extent. Normally, only local land use permits are needed to site wind machines, and no permit is needed for the wind resource, as such. Since wind resources are localized, it is important that wind resource areas have general plan and zoning designations to permit wind development. Height and setback requirements may pose problems for localized development since wind machines are taller than most structures - 40 to 300 feet in height. At some future time, local ordinances may be needed to protect wind rights, to prevent upwind interference.

Local success story – wind

Fairfield, California

The City of Fairfield (population 59,100) in Central Solano County has become one of California's first communities to harness wind power for the generation of electricity. Fairfield has consistent strong winds, averaging about 18 MPH.

As an economic development strategy, the city hopes to use its wind resources to attract industry to the area by providing power reserves that industry often requires. The California Energy Commission provided Fairfield with a grant for the wind turbine generator in December of 1980 on the condition that the city provide the site. Red Top Dairy near the junction of Interstates 80 and 680 was chosen for the windmill site. The city and the property owner reached an agreement and a wind turbine generator was installed in May of 1981.

The wind turbine is manufactured by Jay Carter Enterprises and has a rated capacity of 25 kw. The turbine tower is 56 feet high and the blades are 35 feet from tip to tip. The machine begins turning in a 7 MPH wind and reaches rated capacity in 25 MPH. The rated capacity has been exceeded several times, with a peak output of 30 kw. Since this was a demonstration project, extensive site work and construction of a visitor's center brought the total cost to $93,000; the wind turbine generator itself cost $28,000.

Fairfield is planning to further develop its wind resources through outside financing. The key is to obtain investment and energy tax credits. Fairfield, as a municipality, cannot receive the tax credits, but can make an agreement with an outside party, eligible to receive the tax credits, to provide the capital. The city then provides the land and other amenities not eligible for the credits. In those cases where the city owns the land already, the cost is minimal.

Fairfield hopes to have up to 10 MW of capacity here within the next few years. With the development of its wind resources, Fairfield is taking strong steps to achieve its goal of providing a reserve power supply for industrial growth.

CONTACT: Joe Shilts, Director of Public Works, (707) 425-1031.

Energy from biomass

Characteristics

Biomass resources include organic materials such as: agricultural and forestry wastes, municipal and industrial solid wastes, landfills, manure, wastewater treatment sludge, wood resources, and specially grown fuel crops. They are found in a wide range of forms from whole trees to heterogeneous household wastes to small chips to wet slurries. The resources are often widely dispersed in location. Some types may yield consistent quantities over time, such as municipal solid wastes; others, such as crop residues will fluctuate seasonally. They may be transported to a different location for use.

Recovering energy from biomass may be done through: 1) direct combustion, or burning to produce heat for steam production or to drive a turbine to produce electricity; 2) pyrolysis or gasification to produce oil, gas and char; 3) anaerobic digestion to produce methane gas; and 4) fermentation to produce alcohol. (For more detailed descriptions, see Biofuels: A Survey from Electric Power Research Institute.)

Direct combustion, and the more efficient process cogeneration, accept various fuel stocks. Markets for steam and electricity can be identified. The other three processes remain experimental without widespread applications in this country as yet. Each converts biomass to a new form--gas, oil or char--that in turn may be used as fuel. Wastes with a lower moisture content are best for gasification and direct combustion, whereas waste with higher moisture contents are best for methane production.

Resource Assessment

Assessing the biomass resource requires making estimates of the available quantities in weight or volume. In the case of forestry or agricultural residue a certain amount of waste per acre of production can be expected. (ABAG report Urban Wood Waste establishes methods for estimating quantities of wood waste.) Solid waste quantities may be expressed as pounds per capita or tons annually for a given geographic area. Moisture content is a crucial consideration and may dramatically effect efficiencies of conversion processes. For example, high moisture contents in wood wastes may greatly reduce the energy produced per unit of input for an incineration facility. Assessment must also include identifying the form in which the biomass is available. Additional processing may be needed to separate biomass from contaminants or to reduce particle size. Processing and transporting will add to the cost of biomass as a fuel.

Both rural and urban areas produce tremendous amounts of forest, agricultural, municipal and liquid wastes. These were estimated for 1980 to be over 13 million tons in the Bay Area. (Solid Waste Facilities Study for the San Francisco Bay Area published by ABAG.)

Implementation

The primary implementation issues for any of the conversion processes are associated environmental impacts and the question of ownership of wastes. Combustion or pyrolysis will produce air emissions. Obtaining air quality permits will be key to implementation, particularly of combustion and cogeneration facilities; New Source Review regulations must be met. By-products may need to be disposed of at landfills, in some cases Class I sites. Alcohol production may have safety and water quality impacts. Use of wastes for energy production may conflict with objectives for reducing wastes and recycling.

Local success story – biomass

Burlington, Vermont

The City of Burlington, Vermont (population 37,000) has its own municipally-owned electric utility and operates a small power plant within the city. The utility obtains much of its power from hydro and nuclear, but high cost fuel oil and coal imported from out-of-state provide a significant proportion of its generating capacity.

In 1977, faced with the prospect of increased prices of conventional fuel, a staff member of the Burlington Electric Department initiated the idea of using Vermont's plentiful wood supplies as fuel for electric power generation. The Electric Department personnel converted one of three twenty-five year old steam boilers from coal to wood-fired at a cost of only $25,000. Each boiler has a 10 MW rating and the boiler conversion resulted in a capacity reduction of about 40% (down to 6 MW), due to the lower BTU value of wood. However the wood chip fuel source is cheap, costing only $12 a ton. The converted boiler uses about 200 tons of wood chips a day from nearby forests. Electricity produced by the wood-fired generator costs about .2 cents per KWH compared with the 30 to 35 percent higher cost of producing power with coal in the same unit.

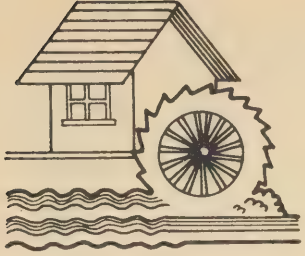
A 50 MW wood-fired generating facility was proposed, and is now in the process of receiving permits and bids on equipment. It is scheduled to be operating commercially by the end of 1982; the entire process from the issuance of the first permits will be approximately four years. Financing was acquired by issuing revenue bonds of 40 million dollars. The 50 MW facility will burn approximately 75 tons of wood chips per hour or half a million to 800,000 tons/year. To ensure the large volume of wood required, contracts with landowners within a 50 mile radius of the city have been negotiated to allow harvesting; the possibility of purchasing forest land for a wood supply is being investigated.

The wood-fired generating facility has received the strong support of the Board of Electric Commissioners, the City Council and the citizens of Burlington. With the new facilities completed, Burlington expects to cut its fuel costs and to reduce its vulnerability to outside fuel price and supply problems.

CONTACT: Tom Carr, Wood Energy Project Manager, (802) 658-0300.

Note: While no Bay Area public agencies have built biomass facilities yet, several are in the planning stages. They are:

- City of Alameda (37 MW)
- Central Contra Costa Sanitary District (10 MW)
- West County Agency (of Contra Costa County) (4 MW)
- San Francisco (34 MW)
- North Santa Clara County Waste Management Joint Powers Authority (20 MW)
- Fremont, Newark, Union City (25 MW)
- Berkeley (5 MW)
- Pleasanton (1 MW)



Hydroelectric energy

Characteristics

Flowing water is a force that can be harnessed to produce energy. Natural streams and rivers as well as man-made water systems such as reservoirs, irrigation canals, and pipelines may be used for hydro power. Water flows will fluctuate seasonally and annually as amount of snow and rainfall affect runoff.

As the name implies, the primary use of energy from water is for producing electricity. Hydroelectric resources can be divided into two types--small and large hydro. Small hydro usually refers to facilities with a capacity under 30 megawatts; such projects often can use existing water resources that may not be currently used for power generation. Large hydro projects generally require the construction of dams and reservoirs. The historical trend has been towards these large-scale storage hydroelectric plants. However, there is renewed interest in small-scale systems due to recent federal regulations which require large utilities to offer favorable prices to small power producers; the environmental impacts of large projects; and scarcity of new sites for these large facilities.

Several types of small turbines are available for small-scale hydroelectric power generation. They can be pre-assembled at the factory and simply connected at the project site.

Resource Assessment

In order to assess how much power a potential site has to offer, such data as the stream velocity, the height the water falls (head), and the average cross-sectional area of the stream must be known. Another consideration is availability of water year round, particularly in view of the proposed use of the power.

Implementation

Development of hydroelectric facilities on undeveloped streams and rivers may create impacts on fish and wildlife. Use of existing water projects as hydro sites should create little or no adverse affects. Several state and federal permits may be required for developers of small hydro projects in addition to local building permits. Required state permits include those dealing with water rights and issues of concern to the Department of Fish and Game. Small hydro projects over 500 kilowatts in size require a permit from the Federal Energy Regulatory Commission (FERC). Permits from the Army Corps of Engineers and the Bureau of Land Management may be required. The state and federal regulatory process for small hydro projects is somewhat lengthy (2 to 4 years), but nearly all projects are approved (state regulations are being reviewed and amendments may speed the process for small hydro projects). Feasibility studies and regulatory procedures account for most of the lead time and much of the non-capital costs associated with small hydroelectric developments.

Local success story – small hydro

La Habra, California

The City of La Habra (population 45,000) in the greater Los Angeles area is one of the first California cities to develop small hydro resources. The city manager became interested in small hydro and decided that the city could use hydropower as a way to cut energy costs and become more energy self-reliant. The city council funded a feasibility study, which looked at the possibility of installing a hydroelectric generator at the junction of the city's and the Metropolitan Water District's water lines. The District's eight-foot pipeline carries a flow of 5,000 cubic feet per second, while the city's tie-in line is only 12 inches in diameter and handles 10 cubic feet of water per second. The city decided to install a reverse flow pump which will take advantage of the pressure difference to produce electricity.

The unit will be housed in a small, 290 square foot plant located under the public right-of-way near a highway. Cost for installing the facility is estimated at $160,800, to be funded through the city's water capital funds. Construction is to start September 1, 1981 and will be completed in November of 1981. The entire time for project development was about 1-1/2 years.

The facility will produce about 760,000 kilowatt hours of electricity per year, or enough power to service 125 homes. Southern California Edison will purchase the electricity generated. La Habra expects to recover its investment within three and a half years, and estimates that profits on the sale of electricity will surpass $1 million over the next twenty years. By identifying an opportunity with the strong support of the city manager, La Habra will be earning revenue for itself with a relatively small initial capital investment.

CONTACT: Bob Buonodono, City Engineer, (213) 694-1011, Ext. 221.

Geothermal energy

Characteristics

Geothermal resources result from the naturally occuring hot water and brine that circulates in porous rocks underground. It is not truly a "renewable" resource, because it will eventually be depleted at a given site.

Geothermal resources may produce energy by direct use of the heat or by production of electricity. Energy is extracted either by drilling wells and bringing hot water or steam to the surface, or by injecting water, some other liquid, or gas and circulating it in pipes through the underground geothermal resource. Geothermal resources tapped by wells are of two predominant types: dry steam and hot water.

The geothermal heat can be used directly in agriculture, space heating and cooling, and some industrial processes. The hot fluids can be transported over limited distances through insulated pipes. In any event, the end use will have to be located near the resource. Electricity is produced by using the geothermal steam to run turbines and generators.

Resource Assessment

The San Francisco Bay Area contains a portion of the Geysers-Calistoga KGRA (Known Geothermal Resource Area), a major source of steam or hot water. This KGRA extends under parts of Lake, Mendocino, Napa and Sonoma Counties; there are several other smaller KGRAs in this area as well. The existence of water wells with higher than normal temperatures and of hot springs in other areas of the four counties indicates that there are geothermal resources outside of the KGRAs. Other potential geothermal areas include the Knoxville KGRA in Napa (as well as Lake and Yolo Counties) County, and the Diablo Range area extending into Santa Clara County. The existence of a viable resource in a specific location can only be proven by the sinking of one or more wells. (The CEC's Geothermal Energy Resources in California - Status Report describes the resource potential in California.)

Implementation

The development of power plants to produce electricity from dry steam may result in the possible loss of ground water, the release of hydrogen sulfide gas, and land use and aesthetic conflicts. Hot water has more side effects, such as air pollution and obnoxious odors from hydrogen sulfide ("rotten egg" gas), ground subsidence, and increased salinity of downstream water.

Permit and license requirements vary, depending upon whether the property is on private, state or federal lands or on lands where mineral rights are owned by the state or federal governments. Drilling permits are required from the California State Division of Oil and Gas. Environmental quality agencies may require additional permits, establishing guidelines on air and/or water emissions.

Local success story – geothermal

City Of Santa Clara, California

In 1968 the City of Santa Clara (population 87,600) joined with ten other municipalities which have publicly-owned electric utility systems and one rural electric cooperative to form the Northern California Power Agency (NCPA). This was accomplished through the signing of a joint-powers agreement. The purpose of NCPA is to "acquire purchase, generate, transmit, distribute, sell, interchange, and pool electrical energy and capacity." In the spring of 1980 construction began on a 110 MW geothermal power plant located in the Geyers area of Sonoma County. The City of Santa Clara is to receive approximately 55% of the power generated when the plant is completed in October of 1982.

Two 55 MW turbine generators will be used to harness the dry steam generated from wells drilled by Shell Oil Company. The plant's electrical output is equivalent to the electricity required for a city of approximately 100,000 people.

The projected cost is 68 million dollars financed seventy-five percent by a loan and the balance financed by revenue bonds. The cost includes the electrical generating plant, access and service roads, electrical transmission lines, air pollution abatement facilities and financing costs.

The NCPA is in the process of negotiating a wheeling agreement with PG&E to distribute the power produced at the plant to its member communities. The NCPA would pay a fee to PG&E to distribute the electricity and the cities would get a credit from PG&E in proportion to their ownership of the geothermal plant.

The NCPA is also in the process of developing two other geothermal power plants in the Geysers area. The first will have 66 MW of capacity and be in operation by early 1985. The second will have a capacity of 55 MW initially, later to be expanded to 110 MW; it should be operating by 1985. The City of Santa Clara will have a 55% and 27% share of these plants, respectively.

With the power generated by geothermal energy resources, combined with its other activities in cogeneration and solar, Santa Clara will have taken significant steps toward increasing its energy-sufficiency and decreasing its vulnerability to price increases associated with fossil fuels.

CONTACT: James Whalen, Project Manager at NCPA, (408) 248-3422.

III. Options for local governments: how do you develop renewable energy resources?

In their economic development strategy for the city, Fairfield administrators found that producing electricity with their abundant wind made good economic sense. Palo Alto chose to promote solar hot water heaters through public education and incentives. These cities' choices of resource, institutional structure, and financing involved a careful assessment of their own capabilities balanced with renewable energy resource potential.

Local governments will need to review three important areas of concern in making decisions about renewable energy:

- Renewable resource development options
- Institutional framework
- Financing

While the final choices about any one of the areas will take into account each of the others, they will be treated separately here to highlight issues.

Renewable resource development options

Careful, realistic assessment of the energy resource potential and project economics are important to designing a practical local renewable program. The California Energy Commission in The Local Energy Planning Handbook has developed a checklist to guide cities and counties in initiating renewable energy projects. The process is summarized below in Table 2 and described more fully in that report.

Table 2.

Procedure for evaluating local renewable resources

Step 1: Inventory local energy resources
- identify sources
- identify conversion technologies
- identify potential by-products
- identify potential sites for conversion facility, if necessary

Step 2: Identify potential users/uses of the resources
- for produced energy
- for by-products

Step 3: Conduct initial resource evaluation
- is it sufficient to produce energy?
- are there over-riding environmental or social impacts?
- are initial economics favorable?

Step 4: Conduct a feasibility study
- obtain permits, if necessary, to conduct study
- detailed evaluation of resource, e.g.:
  - test wells for geothermal or landfill gas development
  - monitor wind speeds during several seasons
  - identify and catalog specific biomass sources/types/transportation costs
  - flow evaluation of streams
  - conduct environmental evaluation of alternative sites, if necessary
  - identify markets for by-products

Step 5: Develop implementation plan
- identify permits/approvals required
- identify potential funding sources
- identify equipment to be used, support facilities needed
- identify energy user(s) and delivery mechanisms

Step 6: Preliminary site/facility design and detailed technical/economic evaluation

Step 7: Begin preliminary negotiations for:
- rights to energy resource, if necessary
- land, access, etc.
- funding
- equipment
- initiate discussion of permits/approvals with agencies

Step 8: File application with lead agency
- environmental documentation is prepared

Step 9: File for other permits as necessary

Step 10: Project implementation initiated

Institutional framework

At a policy level the local elected body should state through resolution or policy statement the intent to promote renewable energy. Going a step further, the council or board could indicate the degree of involvement by the local government. The California Energy Commission has proposed three local government roles in renewable energy development:

- Facilitator
- Broker
- Direct Service

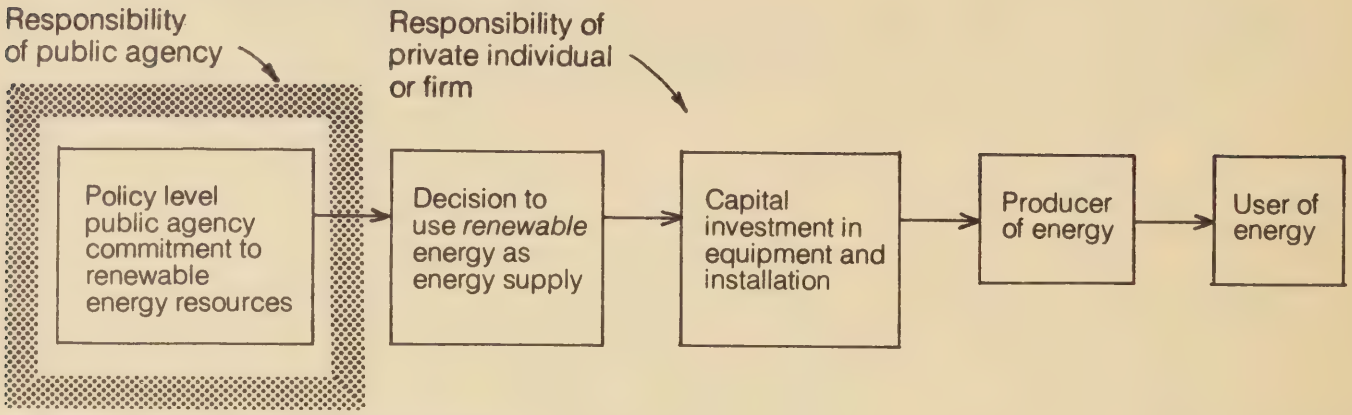
These are not necessarily mutually exclusive, but do imply levels of commitment and risk (see chart). The facilitator role is the most easily assumed by local governments, but probably has the lowest payoff in results. Under a facilitation program, the local government would provide information, education, and marketing on renewable energy systems. Brochures at the permit counter on utility solar loan programs, or workshops on building solar systems would encourage individual actions to use solar. Local ordinances to exempt small wind machine from height limitations, or to ensure access to the sun would remove barriers to renewable energy systems. Marketing efforts on behalf of local solar installers and manufacturers will promote the development of a local industry to provide equipment and services. All of these efforts will assist individuals and businesses to consider options other than conventional fuels.

A second and more active role is referred to as the broker model. The local government becomes a "one-stop" shopping center for a variety of services related to installation of renewable energy equipment. Palo Alto, which has a municipal utility, is setting up a low-interest revolving loan program to help finance solar hot water heater systems. There is more cost in staff and administrative time for the city, but the results in terms of installations are likely to be greater. The staff would need training on the particulars of renewable energy technologies in order to knowledgeably assist and advise applicants for individual systems.

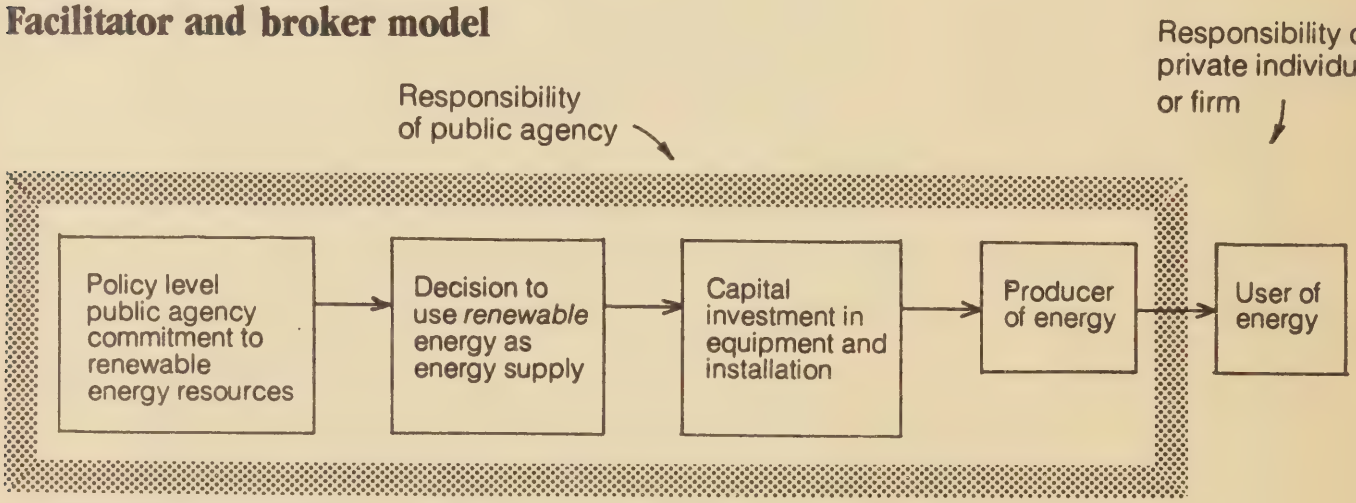
Both the facilitator and broker roles assume that initiative for renewable energy development comes from the private sector, promoted and supported by the public agency. The last role model encompasses a different idea; the city or county in fact becomes a producer of power. The Energy Commission calls this the direct service model. While the first two models rely on individual decisions, direct service puts the local government in an active role with higher risks and higher pay-off. The City of Santa Clara installs and maintains solar systems, while maintaining ownership through rents, leases, or installment sale arrangements. In effect they are supplying energy equipment directly to the end user--that is, decentralized power production. Fairfield generates electricity from wind; the power is sold to PG & E and the revenue returns to the city. Capital investment, operating and maintenance costs, and personnel training all will add considerably to the cost of implementing a direct energy service model. Costs will obviously vary with choice of energy resource and technology.

Figure 2.

Responsibility of public agency and private individual or firm in renewable development


Responsibility of public agency
Responsibility of private individual or firm
Policy level public agency commitment to renewable energy resources
Decision to use *renewable* energy as energy supply
Capital investment in equipment and installation
Producer of energy
User of energy

Facilitator and broker model


Responsibility of private individual or firm
Responsibility of public agency
Policy level public agency commitment to renewable energy resources
Decision to use *renewable* energy as energy supply
Capital investment in equipment and installation
Producer of energy
User of energy

Direct service model

Financing

The biggest question is how to finance renewable energy development. Costs ranging from a few thousand dollars for part of a staff person's time to millions of dollars in capital investment may be implied in the local choice for promoting renewables. Communities vary in their ability to raise needed funds and in the other demands placed on local revenues. Below are described some of the options for financing local renewable energy activities. (Also see chapter on financing options in the California Energy Commission's The Local Energy Planning Handbook).

Internal Conservation Savings - An internal conservation program that results in real and immediate savings in utility bills could include a strategy to turn those savings around into funding for other energy activities, including renewable energy. An internal accounting of conservation actions taken, of resultant savings, and of responsible

departments or personnel would assist evaluation of measures and serve to highlight dollars saved. The case for using this money on other energy activities would then be strengthened.

Municipal Reserves - Local reserves, if available, may offer a simple way to begin renewable energy development. An important rationale for spending reserves in this way would be the likelihood of return on investment. As described earlier, not all renewable energy activities will result in revenue to the local government. Production and sale of electricity may be a good choice if the economics of the project appear favorable.

Local Bonding Capability - Several types of tax-exempt bonds could be used for financing renewable energy development. These would be applicable to projects that require substantial initial capital investments, such as a solid waste-to-energy facility. The following bonding options may work for local government development of renewable energy: revenue bonds, joint power bonds, lease-revenue bonds, non-profit corporation bonds, non-profit corporation lease-revenue bonds, industrial development bonds. (These options are discussed in an article entitled, "Tax Exempt Financing of Solar Facilities," by Sharon Stanton White, from the Municipal Finance Journal, Spring 1980.)

State or Federal Grants and Loans - Grant and loan programs often are resource specific, intended to promote their development. While large amounts of funding may not be available in the future, even small amounts can boost a beginning effort. The City of Fairfield was able to build its first wind turbine generator with a California Energy Commission grant.

Private Sector Resources - As public money becomes more scarce, funds from private sources will be ever more attractive. Options include funds from utilities, banks, savings and loans, corporations, and local pension funds. Public/private partnerships are emerging as a viable possibility.

Appendices Glossary and Bibliography

Appendix A

PURPA and California's response

In November of 1978, Congress adopted the Public Utility Regulatory Policies Act (PURPA) which has major significance for small power producers. Although the Act has several titles, of particular concern to small power producers are sections 201 and 210 under Title II, which require utilities to interconnect with small power producers and to purchase excess electricity from them at reasonable rates. According to a Federal Energy Regulatory Commission (FERC) study the new requirements will prompt production of approximately 12,000 megawatts of additional electric capacity annually by 1995; 5,900 MW would come from industrial and commercial cogeneration; 3,500 MW from small hydro; 360 MW from municipal solid-waste systems; and 1,900 MW from wind energy conversion systems.

PURPA requires that rates between private producers and utilities shall be reasonable and not discriminate against small power producers. Also any rate charged for the interconnection between a producer and the utility must be reasonable. The utility must buy power at the price of its avoided cost, or the amount that a utility would have to pay to produce the same amount of power by constructing new generating capacity. If the cost of purchasing fuel supplies continues to rise, avoided cost will rise also, which may result in attractive economics for small power projects.

The FERC rules provided that an electric generating system, other than a cogenerator, using biomass, renewable resources or any combination of the above for more than 50 percent of its energy input, qualifies. They must produce less than 80 MW. Cogenerators that burn fossil fuels, and small hydro facilities over 5MW are subject to other federal licensing requirements.

While writing and implementing regulations for PURPA are FERC's responsibilities, many key issues are left to state public utility commissions to decide. In the case of unregulated utilities (mostly owned by municipalities), the utilities themselves bear that responsibility.

Implementing the FERC regulations in California is the responsibility of the California Public Utilities Commission (CPUC). On September 3, 1980 the CPUC issued Order Instituting Rulemaking No. 2 (OIR-2) to formally provide for proceedings to establish standards governing the prices, terms, and conditions of utility purchases of electricity from qualifying facilities. OIR-2 serves as California's proceeding to fully establish the CPUC role and all standards to be adopted in implementing the FERC regulations.

Several issues have emerged that CPUC must resolve. These include: capacity payments for intermittent power deliveries, establishment of a fair rate that reflects changes in future energy costs, performance standards for qualifying facilities to receive capacity payments, and the role of the PUC itself.

Despite unresolved issues, small power projects are proceeding with price offers being made at full avoided costs. California is showing strong support for small power producers and cogenerators and is taking strong steps to implement PURPA statewide.

Appendix B

Who to contact about renewable energy?

GENERAL INFORMATION NUMBERS

- California Energy Commission (CEC), Small Power Producers Office, (916) 924-2496--provides information on small scale power production, especially co-generation, small hydro, wind and geothermal.
- Department of Energy (DOE), Energy Information Center, (415) 764-7035--a centralized source of energy information.
- Pacific Gas & Electric Company, (415) 781-4211--to get information on prices for electricity, contracts and grid connections and equipment maintenance.

SOLAR

- Solar Office, CEC, (916) 920-6011 or 6019--for general information on solar and for assistance with developing and financing MSU's.
- Western SUN, California Office, (916) 920-7623--for funding and source information and general information on community solar activities and local government solar initiatives.

WIND

- Wind Information Center, CEC, (916) 924-2490--provides assistance and general information on wind energy.

BIOMASS

- Biomass Program, Development Division, CEC, (916) 920-6025--conducts assessments of biomass resources and energy conversion technologies available to utilize the resource.
- State Solid Waste Management Board, (916) 322-6329 -- the board's resource recovery program focuses on siting, constructing and operating a solid waste-to-energy conversion facility.
- Department of Forestry, Wood Energy Program, (916) 322-0107--has done work with forest harvesting residues and a mobile pyrolysis unit.

HYDRO

- Department of Water Resources, Energy Division, (916) 445-6687--for assistance with locating and developing hydro resources.

GEOTHERMAL

- Geothermal Research, Information and Planning Services (GRIPS), (707) 527-2025--is responsible for providing assistance with geothermal development in Sonoma, Napa, Lake and Mendocino Counties.

- Geothermal Division, DOE, (415) 764-7084--provides information and technical assistance for developers.

CO-GENERATION

- Air Resources Board, contact: Praven Amar, (916) 322-8267--for information on cogeneration.

Glossary

ANAEROBIC DIGESTION - A type of fermentation which refers to the production of methane gas.

AVOIDED COSTS - Term used in the Federal Energy Regulatory Commission regulations to indicate that a qualifying power facility must receive a price roughly equal to the utility's energy cost savings and any demand cost savings (if the utility can eliminate or delay new capacity construction or retire an existing inefficient plant).

BIOMASS - An energy source derived directly or indirectly from organic plant material. It can include trees, crops, aquatic plants and even natural ecosystems. It may be divided into three categories: wastes, residues and fuel crops.

BTU - British Thermal Unit: The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

COGENERATION - The sequential production of electricity and heat, steam, or usable work from the same fuel source.

ENERGY EFFICIENCY - Synonymous with energy conservation; that is using energy in a way that best matches energy produced and useful work accomplished, and that eliminates waste.

FERMENTATION - Biological conversions resulting from microbial processes carried out in the absence of oxygen. A large variety of organic chemicals are produced including hydrogen, ethanol, methane and other alcohols.

KILOWATT (KW) - One thousand watts.

KILOWATT-HOUR (KWH) - The basic unit of energy equal to one kilowatt of power supplied to or taken from an electric circuit steadily for one hour.

MEGAWATT (MW) - One thousand kilowatts, or one million watts.

MUNICIPAL SOLAR UTILITY (MSU) - A local government organization which performs one or more functions such as financing, installing, owning, billing for the use of, and/or maintaining solar systems installed for private or commercial use.

NON-RENEWABLE ENERGY RESOURCES - Energy resources that rely on oil, gas, coal or uranium.

PHOTOVOLTAIC CELLS - A type of semiconductor in which the absorption of light energy creates a separation of electrical charges. The net effect is the direct conversion of light into electricity.

PYROLYSIS AND GASIFICATION - The heating of biomass in the absence of air to produce mixtures of gaseous, liquid and solid fuels. In general, pyrolysis refers to lower temperature processes that favor liquid and solid fuel formation, while gasification is a higher temperature process that results almost exclusively in gaseous fuels.

RENEWABLE ENERGY RESOURCES - Energy resources that are sustainable over time, such as solar, wind, biomass, geothermal, and hydropower.

SOLAR ACCESS - The availability of sunlight to solar collectors and energy systems.

WATT - A unit of electric power

WIND ENERGY CONVERSION SYSTEMS (WECS) OR WIND TURBINE GENERATORS (WTG) - A machine which uses the wind's kinetic energy to produce electricity by driving a rotor which in turn drives an electrical generator.

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